Proposed Development – Campbelltown Hospital

Arboricultural Impact Assessment

Prepared for
Health Infrastructure c/o Root Partnerships

July 2018

DOCUMENT TRACKING

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Abbreviations

Abbreviation	Description
AQF	Australian Qualifications Framework
AS	Australian Standards
DBH	Diameter at Breast Height
ELA	Eco Logical Australia
m	Metre
mm	Millimetre
NDE	Non-Destructive Excavation
NO	Number
NSW	New South Wales
SP	Species
SRZ	Structural Root Zone
TPZ	Tree Protection Zone
VTA	Visual Tree Assessment

1 Background

1.1 Introduction

Eco Logical Australia Pty Ltd (ELA) was commissioned by Health Infrastructure to prepare an arboricultural impact assessment for a proposed development at Campbelltown Hospital.

The purpose of this report is to:

- identify the trees within the site that are likely to be affected by the proposed works
- assess the current overall health and condition of the subject trees, and their retention value
- evaluate the impact to those trees.

1.2 The proposal

Campbelltown Hospital will be redeveloped to provide a new clinical services building, on-grade car park, internal access roadworks, and a connection road from Appin Road. It has been assumed that all vegetation within the development footprint will be removed and all impacts have been based on a 'worst-case scenario'.

The key features of the proposed construction likely to negatively affect the subject trees can be summarised as follows:

- excavation works
- plant movement
- changes in soil grades
- installation of underground services.

1.3 The subject trees

148 trees were assessed. A map of the study area is in **Appendix A**.

Further information, observations and measurements specific to each of the subject trees can be found in **Appendix B.**

1.4 Documents and plans referenced

The conclusions and recommendations of this report are based on the *Australian Standard, AS 4970-2009, Protection of Trees on Development Sites*, the findings from the site inspections and analysis of the following documents/plans:

- *Site Plan Proposed Works SSD-01-003;* supplied by Root Partnerships 27/05/18.

2 Method

2.1 Visual tree assessment

The subject trees were inspected on 28 May 2018. Only trees taller than 4 m and with a DBH greater than 200 mm were assessed.

The subject trees were assessed in accordance with a stage one visual tree assessment (VTA) as formulated by Mattheck & Breloer (1994)[1], and practices consistent with modern arboriculture.

The following limitations apply to this methodology:

- Trees were inspected from ground level, without the use of any invasive or diagnostic tools and testing.
- No aerial inspections or root mapping was undertaken.
- Tree heights, canopy spread and diameter at breast height (DBH) was estimated, unless otherwise stated.
- Tree identification was based on broad taxonomical features present and visible from ground level at the time of inspection.

2.2 Retention Value

The retention value/importance of a tree or group of trees, is determined using a combination of environmental, cultural, physical and social values.

- **Low:** These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.
- **Medium:** These trees are moderately important for retention. Their removal should only be considered if adversely affected by the proposed works and all other alternatives have been considered and exhausted.
- **High:** These trees are considered important and should be retained and protected. Design modification or re-location of building/s should be considered to accommodate the setbacks as prescribed by *Australian Standard AS4970 Protection of trees on development sites*.

This tree retention assessment has been undertaken in accordance with the *Institute of Australian Consulting Arboriculturists* (IACA) *Significance of a Tree, Assessment Rating System* (STARS). Further details and assessment criteria are in **Appendix D**.

[1] VTA is an internationally recognised practice in the visual assessment of trees as prescribed by Mattheck, C. and Breloer, H. 1994. 'Field Guide for Visual Tree Assessment' *Arboricultural Journal*, Vol 18 pp 1-23.

2.3 Protection zones

- **Tree protection zone (TPZ):** The TPZ is the optimal combination of crown and root area (as defined by AS 4970-2009) that requires protection during the construction process. The TPZ is an area that is isolated from the work zone to ensure no disturbance or encroachment occurs into this zone. Tree sensitive construction measures must be implemented if works are to proceed within the Tree Protection Zone.
- **Structural root zone (SRZ):** The SRZ is the area of the root system (as defined by AS 4970-2009) used for stability, mechanical support and anchorage of the tree. It is critical for the support and stability of the tree, and provides the bulk of mechanical support and anchorage. Severance of roots (>50 mmØ) within the SRZ is generally not recommended as it may lead to the destabilisation and/or decline of the tree.
- **Root investigation:** When assessing the potential impacts of encroachment into the TPZ consideration will need to be given to the location and distribution of the roots, including above or below ground restrictions affecting root growth. Location and distribution of roots may be determined through non-destructive excavation (NDE) methods such as hydro-vacuum excavation (sucker truck), air spade and manual excavation. Root investigation is used to determine the extent and location of roots within the zone of conflict. Root investigation does not guarantee the retention of the tree.

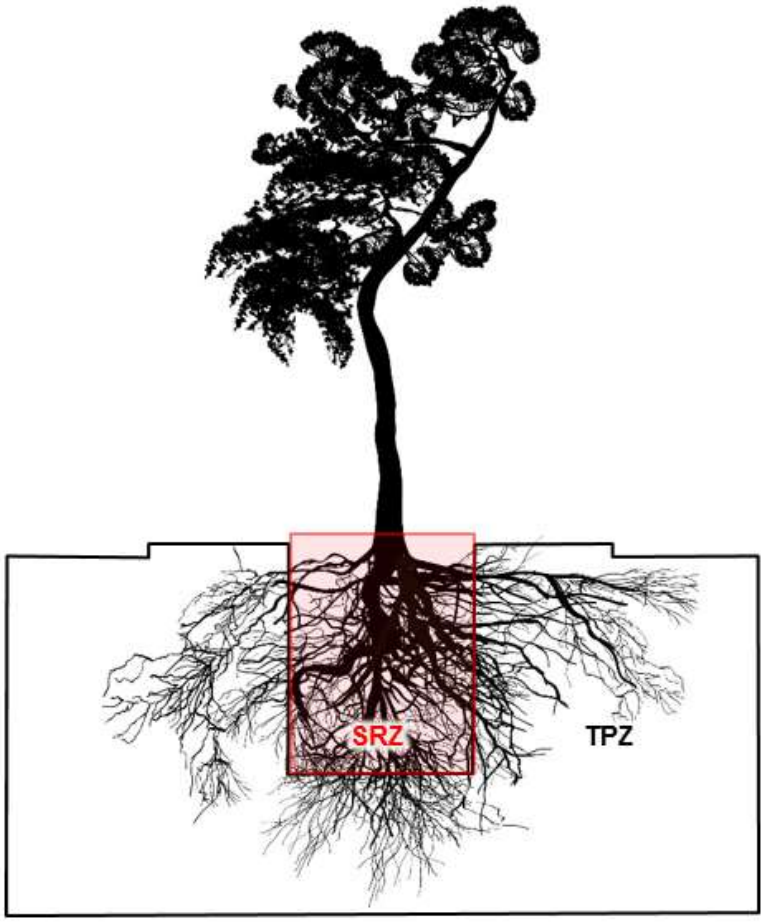

Figure 1: Indicative TPZ and SRZ

2.4 Impacts within the TPZ

- **No impact (0%):** No likely or foreseeable encroachment within the TPZ.
- **Low impact (<10%):** If the proposed encroachment is less than 10% (total area) of the TPZ, and outside of the SRZ, detailed root investigations should not be required. The area lost to this encroachment should be compensated for elsewhere, and be contiguous with the TPZ.
- **Medium impact (<20%):** If the proposed encroachment is greater than 10% of the TPZ and outside of the SRZ, the project arborist must demonstrate that the tree(s) remain viable. The area lost to this encroachment should be compensated for elsewhere, and be contiguous with the TPZ. All work within the TPZ must be carried out under the supervision of the project arborist.
- **High impact (>20%):** If the proposed encroachment is greater than 20% of the TPZ the SRZ may be impacted. Tree sensitive construction techniques may be used for minor works within this area providing no structural roots are likely to be impacted, and the project arborist can demonstrate that the tree(s) remain viable. Root investigation by non-destructive methods is essential for any proposed works within this area.

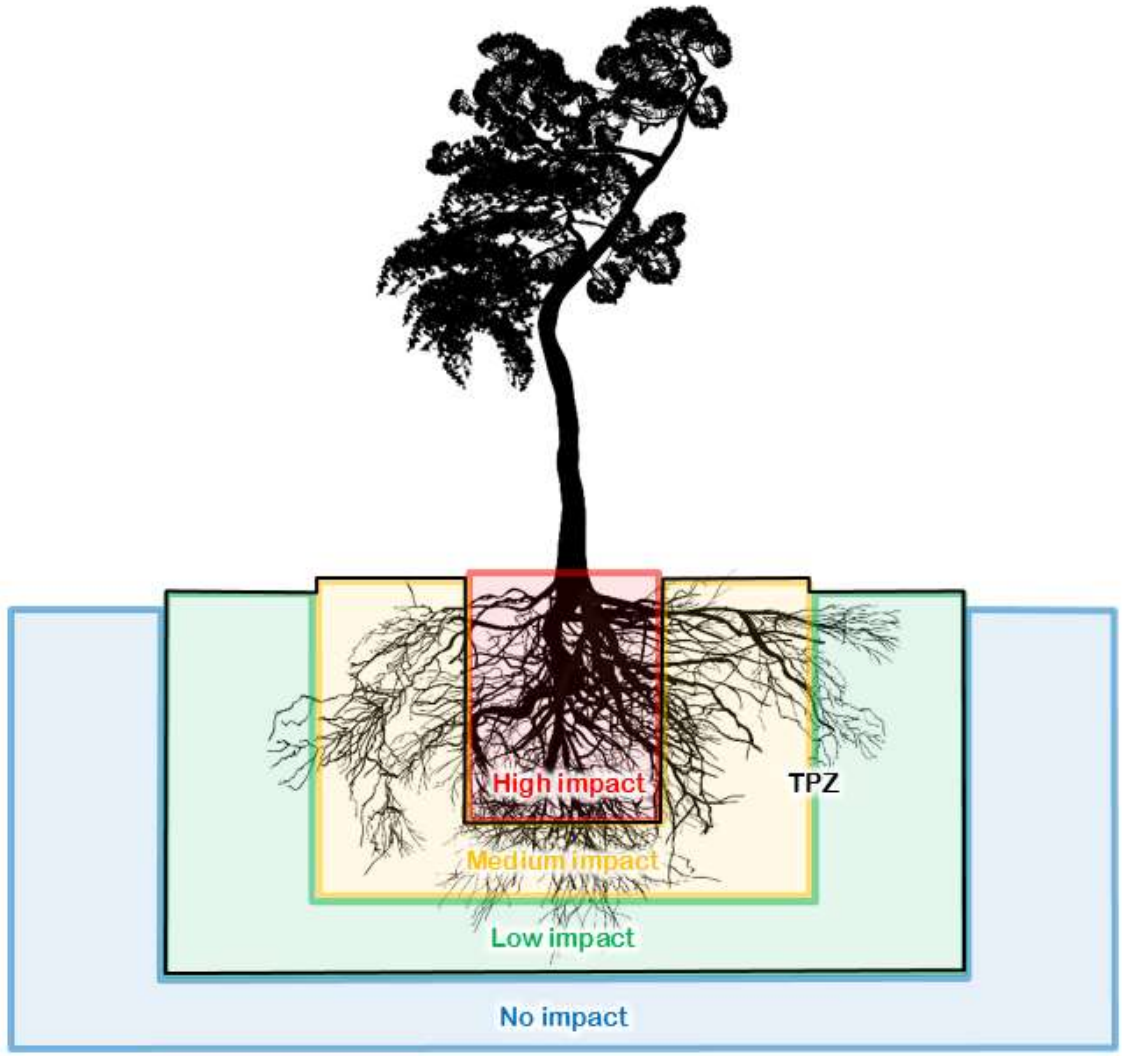

Figure 2: Indicative zones of impact within the TPZ

2.5 Mitigation measures

Encroachment within the TPZ must be offset with a range of mitigation measures to ensure that impacts to the subject tree(s) are reduced or restricted wherever possible. Mitigation must be increased relative to the level of encroachment within the TPZ to ensure the subject tree remains viable. **Table 1** outlines mitigation requirements under AS 4970-2009 within each category of encroachment.

Table 1: Mitigation measures

Impact	Requirements under AS 4970-2009	Mitigation (design phase)	Mitigation (construction phase)
Low impact (<10%)	• The area lost to this encroachment should be compensated for elsewhere, contiguous with the TPZ. • Detailed root investigations should not be required.	• N/A	• The area lost to this encroachment should be compensated for elsewhere, contiguous with the TPZ. • Tree protection must be installed.
Medium impact (<20%)	• The project arborist must demonstrate the tree(s) would remain viable. • Root investigation by non-destructive methods may be required. • Consideration of relevant factors including: Root location and distribution, tree species, condition, site constraints and design factors. • The area lost to this encroachment should be compensated for elsewhere, contiguous with the TPZ.	The following design changes should be considered to retain trees where practicable, considering the retention value of the tree and the complexity and cost of the change. • Relocate services/pathways outside of tree protection zones • Design services to be installed at a minimum depth of 1200mm below ground to avoid impact to the root zones of trees. • Design pathways to be installed on or above grade, minimising/eliminating excavation within tree protection zones. • Design pathways using porous materials (eco-paving, porous asphalt, decomposed granite) to allow water and oxygen to reach the root zone. • Design pathways using tree sensitive techniques (pier and beam, suspended slabs). • The area lost to encroachment should be compensated for elsewhere, contiguous with the TPZ.	• The area lost to this encroachment should be compensated for elsewhere, contiguous with the TPZ. • The project arborist would be consulted for any works within the TPZ. • Tree protection must be installed. • Tree sensitive techniques can be used to install services within the TPZ. Horizontal directional drilling (HDD), boring, non-destructive excavation (NDE). • Location and distribution of roots may be determined through non-destructive excavation (NDE) methods such as hydro-vacuum excavation (sucker truck), air spade and manual excavation.
High impact (>20%)		• Relocate services/pathways outside of tree protection zones • Design services to be installed at a minimum depth of 1200mm below ground to avoid impact to the root zones of trees. • Design pathways to be installed on or above grade, minimising/eliminating excavation within tree protection zones. • Design pathways using porous materials (eco-paving, porous asphalt, decomposed granite) to allow water and oxygen to reach the root zone. • Design pathway using tree sensitive techniques (pier and beam, suspended slabs). • The area lost to encroachment can be compensated for elsewhere, contiguous with the TPZ.	• As above • Removal of existing hard surfaces should be undertaken manually to avoid root damage. • Tree sensitive techniques can be used to install the services: Horizontal directional drilling (HDD), boring, non-destructive excavation (NDE).

3 Results and discussion

3.1 Results

Results are mapped and tabulated in **Appendices A** and **B.** Key points are:

- **High impact (>20%): 53** trees will be removed under the current proposal. Of these:
  - 2 trees are of high retention value (both *Corymbia maculata* – Trees 1 and 95)
  - 47 trees are of medium retention value
  - 4 trees are of low retention value
- **Medium impact (<20%): 7** trees will be subject to a medium impact <20% of the TPZ. Of these:
  - 6 trees are of medium retention value (one *Eucalyptus moluccana* and five *Corymbia maculata*)
  - 1 tree is of low retention value (*Corymbia maculata*).
  - Further detailed assessments (root investigation) via non-destructive methods will be required to determine the suitability of retention for medium impact trees.
- **No impact: 88** trees will not be impacted by the proposed development. Under the current proposal, these trees can be successfully retained. Of these:
  - 5 trees are of high retention value
  - 67 trees are of medium retention value
  - 16 trees are of low retention value

3.2 Tree work

- All tree work is to be carried out by an arborist with a minimum AQF Level 3 qualification in Arboriculture.
- All tree work must be in accordance with Australian Standard AS 4373-2007, Pruning of Amenity Trees and the NSW WorkCover Code of Practice for the Amenity Tree Industry (1998).
- Permission must be granted from the relevant consent authority, prior to removing or pruning of any of the subject trees.

3.3 Offsetting

The removal of native vegetation will be offset in accordance with the Biodiversity Offsets Scheme, as detailed in the Biodiversity Development Assessment Report.

4 Tree protection plan

4.1 Tree protection measures

The following tree protection measures will be required if trees are retained:

- Tree protection fencing must be established around the perimeter of the TPZ. If the protective fencing requires temporary removal, trunk, branch and ground protection must be installed and must comply with *AS 4970-2009 - Protection of trees on development sites*. Existing fencing and site hoarding may be used as tree protection fencing.
- If temporary access for machinery is required within the TPZ, ground protection measures will be required. The purpose of ground protection is to prevent root damage and soil compaction within the TPZ. Ground protection may include a permeable membrane such as geotextile fabric beneath a layer of mulch, crushed rock or rumble boards.
- Any additional construction activities within the TPZ of the subject trees must be assessed and approved by the project arborist, and must comply with *AS 4970-2009 - Protection of trees on development sites.*

Further information and guidelines on tree protection is in **Appendix C**.

4.2 Hold points, inspection and certification

The approved tree protection plan must be available onsite prior to the commencement of works, and throughout the entirety of the project. To ensure the tree protection plan is implemented, hold points have been specified in the schedule of works below. It is the responsibility of the principal contractor to complete each of the tasks.

Once each stage is reached, the work will be inspected and certified by the project arborist and the next stage may commence. Alterations to this schedule may be required due to necessity, however, this shall be through consultation with the project arborist only.

Table 2: Schedule of works

Pre-construction	Prior to demolition and site establishment indicate clearly (with spray paint on trunks) trees marked for removal only.
	Tree protection (for trees that will be retained) shall be installed prior to demolition and site establishment, this will include mulching of areas within the TPZ
During Construction	Scheduled inspection of trees by the project arborist should be undertaken monthly during the construction period.
	Inspection of trees by project arborist after all major construction has ceased, following the removal of tree protection measures.
Post Construction	Final inspection of trees by project arborist.

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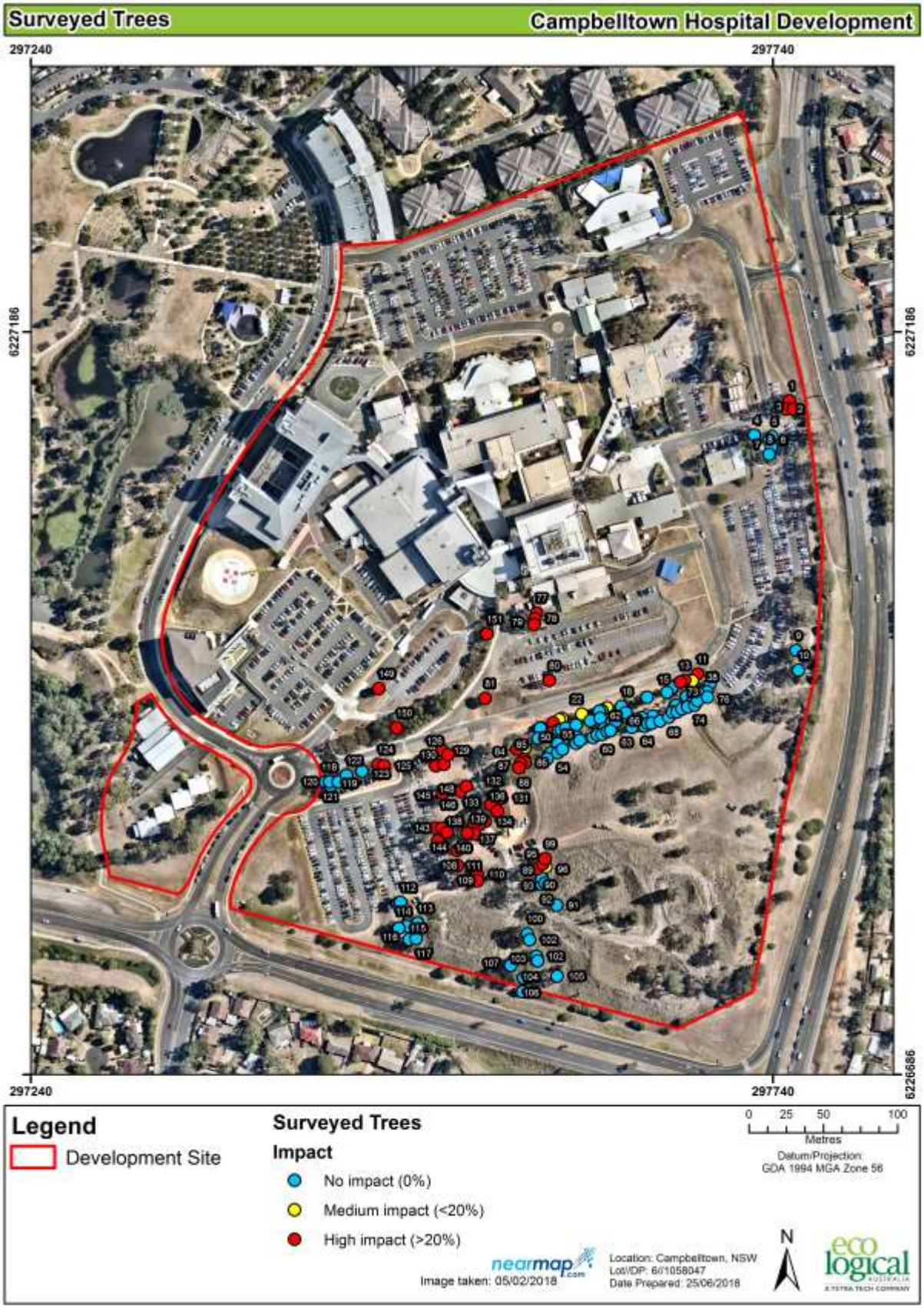
Appendix A – Tree locations and impacts



Appendix B – Results of arboricultural assessment

Ref.	Species	Trees in group	Height (m)	Spread (m)	Health	Structure	Retention value	DBH (mm)	TPZ (m)	Impact
1	*Corymbia maculata*	1	16	10	Good	Good	High	500	6	High impact (>20%)
2	*Eucalyptus moluccana*	1	4	4	Fair	Fair	Medium	500	6	High impact (>20%)
3	*Eucalyptus moluccana*	1	5	2	Fair	Fair	Low	100	2	High impact (>20%)
4	*Eucalyptus moluccana*	1	12	13	Fair	Poor	Medium	550	6.6	No impact (0%)
5	*Eucalyptus moluccana*	1	8	10	Fair	Fair	Medium	200	2.4	No impact (0%)
6	*Eucalyptus moluccana*	1	10	5	Poor	Poor	Low	200	2.4	No impact (0%)
7	*Eucalyptus sp.*	1	10	3	Poor	Poor	Low	350	4.2	No impact (0%)
8	*Eucalyptus scoparia*	1	10	10	Fair	Good	Medium	450	5.4	No impact (0%)
9	*Corymbia maculata*	1	8	3	Good	Fair	Low	150	2	No impact (0%)
10	*Corymbia maculata*	1	10	4	Fair	Fair	Medium	200	2.4	No impact (0%)
11	*Eucalyptus fibrosa*	1	10	6	Good	Good	Medium	250	3	High impact (>20%)
12	*Eucalyptus moluccana*	1	14	8	Good	Good	Medium	300	3.6	Medium impact (<20%)
13	*Eucalyptus crebra*	1	12	6	Fair	Good	Medium	250	3	High impact (>20%)
14	*Eucalyptus crebra*	1	6	5	Fair	Fair	Medium	200	2.4	No impact (0%)

Ref.	Species	Trees in group	Height (m)	Spread (m)	Health	Structure	Retention value	DBH (mm)	TPZ (m)	Impact
15	*Eucalyptus fibrosa*	1	12	6	Fair	Good	Medium	250	3	High impact (>20%)
16	*Eucalyptus fibrosa*	1	11	5	Good	Fair	Medium	250	3	No impact (0%)
17	*Corymbia maculata*	1	15	8	Good	Good	Medium	300	3.6	No impact (0%)
18	*Corymbia maculata*	1	8	5	Good	Good	Medium	250	3	No impact (0%)
19	*Corymbia maculata*	1	10	6	Good	Good	Medium	400	4.8	Medium impact (<20%)
20	*Corymbia maculata*	1	10	4	Fair	Good	Medium	250	3	No impact (0%)
21	*Corymbia maculata*	1	10	5	Fair	Poor	Medium	300	3.6	No impact (0%)
22	*Corymbia maculata*	1	12	8	Good	Fair	Medium	350	4.2	Medium impact (<20%)
23	*Corymbia maculata*	1	12	6	Good	Fair	Medium	300	3.6	Medium impact (<20%)
24	*Corymbia maculata*	1	10	5	Fair	Good	Medium	300	3.6	Medium impact (<20%)
25	*Corymbia maculata*	1	8	6	Good	Fair	Medium	300	3.6	High impact (>20%)
26	*Corymbia maculata*	1	8	5	Fair	Fair	Medium	200	2.4	No impact (0%)
27	*Eucalyptus sp.*	1	7	6	Poor	Fair	Low	200	2.4	No impact (0%)
28	*Eucalyptus sp.*	1	10	4	Poor	Poor	Low	300	3.6	High impact (>20%)
29	*Eucalyptus sp.*	1	9	5	Poor	Poor	Low	250	3	No impact (0%)
30	*Eucalyptus sp.*	1	9	5	Poor	Poor	Low	250	3	No impact (0%)
31	*Eucalyptus sp.*	1	9	5	Poor	Poor	Low	200	2.4	No impact (0%)

Ref.	Species	Trees in group	Height (m)	Spread (m)	Health	Structure	Retention value	DBH (mm)	TPZ (m)	Impact
32	*Eucalyptus sp.*	1	8	4	Poor	Poor	Low	250	3	No impact (0%)
33	*Eucalyptus sp.*	1	6	4	Poor	Poor	Low	200	2.4	No impact (0%)
34	*Eucalyptus sp.*	1	8	5	Poor	Poor	Low	250	3	No impact (0%)
35	*Corymbia maculata*	1	7	5	Fair	Fair	Medium	200	2.4	No impact (0%)
36	*Eucalyptus crebra*	1	10	5	Fair	Good	Medium	200	2.4	No impact (0%)
37	*Casuarina glauca*	1	10	5	Good	Good	Medium	250	3	No impact (0%)
38	*Eucalyptus tereticornis*	1	12	8	Good	Poor	Medium	400	4.8	No impact (0%)
39	*Eucalyptus crebra*	1	10	6	Fair	Good	Medium	200	2.4	No impact (0%)
40	*Eucalyptus crebra*	1	10	5	Good	Good	Medium	200	2.4	No impact (0%)
41	*Eucalyptus crebra*	1	10	4	Good	Fair	Medium	200	2.4	No impact (0%)
42	*Eucalyptus fibrosa*	1	9	8	Fair	Fair	Medium	250	3	No impact (0%)
43	*Eucalyptus fibrosa*	1	10	5	Fair	Good	Medium	200	2.4	No impact (0%)
44	*Eucalyptus fibrosa*	1	10	5	Fair	Fair	Medium	200	2.4	No impact (0%)
45	*Eucalyptus crebra*	1	9	5	Fair	Good	Medium	200	2.4	No impact (0%)
46	*Eucalyptus fibrosa*	1	11	7	Fair	Fair	Medium	400	4.8	No impact (0%)
47	*Eucalyptus moluccana*	1	8	7	Poor	Poor	Low	250	3	No impact (0%)
48	*Eucalyptus moluccana*	1	8	5	Poor	Poor	Medium	250	3	No impact (0%)

Ref.	Species	Trees in group	Height (m)	Spread (m)	Health	Structure	Retention value	DBH (mm)	TPZ (m)	Impact
49	*Casuarina glauca*	1	10	4	Fair	Fair	Medium	200	2.4	No impact (0%)
50	*Eucalyptus moluccana*	1	8	5	Fair	Fair	Medium	250	3	No impact (0%)
51	*Eucalyptus moluccana*	1	7	4	Fair	Fair	Medium	200	2.4	No impact (0%)
52	*Eucalyptus moluccana*	1	8	4	Fair	Poor	Medium	250	3	No impact (0%)
53	*Eucalyptus sp.*	1	9	5	Fair	Fair	Medium	250	3	No impact (0%)
54	*Casuarina glauca*	1	8	3	Fair	Good	Medium	200	2.4	No impact (0%)
55	*Eucalyptus sp.*	1	10	5	Fair	Fair	Medium	250	3	No impact (0%)
56	*Eucalyptus sp.*	1	10	6	Fair	Fair	Medium	200	2.4	No impact (0%)
57	*Casuarina glauca*	1	12	3	Good	Good	Medium	200	2.4	No impact (0%)
58	*Eucalyptus moluccana*	1	12	8	Fair	Poor	Medium	300	3.6	No impact (0%)
59	*Eucalyptus moluccana*	1	11	5	Fair	Good	Medium	300	3.6	No impact (0%)
60	*Eucalyptus crebra*	1	10	3	Fair	Poor	Medium	200	2.4	No impact (0%)
61	*Eucalyptus moluccana*	1	10	6	Fair	Poor	Medium	250	3	No impact (0%)
62	*Corymbia maculata*	1	12	6	Fair	Good	Medium	250	3	No impact (0%)
63	*Eucalyptus moluccana*	1	10	6	Good	Good	Medium	300	3.6	No impact (0%)
64	*Eucalyptus moluccana*	1	11	4	Fair	Poor	Medium	250	3	No impact (0%)
65	*Eucalyptus moluccana*	1	10	3	Fair	Fair	Medium	250	3	No impact (0%)

Ref.	Species	Trees in group	Height (m)	Spread (m)	Health	Structure	Retention value	DBH (mm)	TPZ (m)	Impact
66	*Eucalyptus moluccana*	1	10	7	Fair	Good	Medium	250	3	No impact (0%)
67	*Eucalyptus moluccana*	1	12	10	Fair	Poor	Medium	450	5.4	No impact (0%)
68	*Eucalyptus moluccana*	1	10	5	Poor	Poor	Low	300	3.6	No impact (0%)
69	*Eucalyptus moluccana*	1	12	4	Fair	Good	Medium	250	3	No impact (0%)
70	*Eucalyptus moluccana*	1	11	4	Fair	Fair	Medium	250	3	No impact (0%)
71	*Eucalyptus moluccana*	1	12	7	Fair	Fair	Medium	300	3.6	No impact (0%)
73	*Eucalyptus fibrosa*	1	8	5	Fair	Fair	Medium	250	3	No impact (0%)
74	*Eucalyptus fibrosa*	1	10	4	Good	Fair	Medium	200	2.4	No impact (0%)
75	*Eucalyptus crebra*	1	12	5	Fair	Fair	Medium	250	3	No impact (0%)
76	*Eucalyptus moluccana*	1	14	10	Fair	Fair	Medium	350	4.2	No impact (0%)
77	*Corymbia citriodora*	1	15	9	Good	Fair	Medium	400	4.8	High impact (>20%)
78	*Eucalyptus moluccana*	1	10	5	Good	Fair	Medium	200	2.4	High impact (>20%)
79	*Corymbia citriodora*	1	14	10	Good	Good	Medium	300	3.6	High impact (>20%)
80	*Corymbia maculata*	1	12	6	Fair	Fair	Medium	300	3.6	High impact (>20%)
81	*Jacaranda mimosifolia*	1	7	7	Fair	Fair	Medium	300	3.6	High impact (>20%)
82	*Corymbia maculata*	1	25	20	Fair	Good	Medium	450	5.4	High impact (>20%)
83	*Corymbia maculata*	1	25	18	Good	Good	Medium	450	5.4	Medium impact (<20%)

Ref.	Species	Trees in group	Height (m)	Spread (m)	Health	Structure	Retention value	DBH (mm)	TPZ (m)	Impact
84	*Corymbia maculata*	1	25	18	Fair	Good	Medium	450	5.4	High impact (>20%)
85	*Corymbia maculata*	1	18	15	Fair	Good	Medium	350	4.2	High impact (>20%)
86	*Corymbia maculata*	1	25	18	Good	Good	Medium	500	6	High impact (>20%)
87	*Corymbia maculata*	1	20	15	Fair	Good	Medium	400	4.8	High impact (>20%)
88	*Corymbia maculata*	1	22	16	Fair	Fair	Medium	450	5.4	High impact (>20%)
89	*Corymbia maculata*	1	24	18	Fair	Fair	Medium	450	5.4	No impact (0%)
90	*Corymbia maculata*	1	24	15	Fair	Fair	Medium	400	4.8	No impact (0%)
91	*Corymbia maculata*	1	25	20	Good	Good	High	550	6.6	No impact (0%)
92	*Corymbia maculata*	1	20	10	Good	Fair	Medium	350	4.2	No impact (0%)
92	*Corymbia maculata*	1	23	15	Fair	Good	Medium	400	4.8	No impact (0%)
93	*Corymbia maculata*	1	18	12	Fair	Poor	Low	350	4.2	No impact (0%)
95	*Corymbia maculata*	1	25	16	Good	Fair	High	600	7.2	High impact (>20%)
96	*Corymbia maculata*	1	15	10	Fair	Poor	Low	350	4.2	Medium impact (<20%)
98	*Corymbia maculata*	1	10	10	Fair	Fair	Medium	400	4.8	High impact (>20%)
99	*Corymbia maculata*	1	10	5	Fair	Fair	Medium	250	3	High impact (>20%)
100	*Corymbia maculata*	1	20	15	Good	Fair	High	500	6	No impact (0%)
102	*Corymbia maculata*	1	18	15	Good	Good	High	500	6	No impact (0%)

Ref.	Species	Trees in group	Height (m)	Spread (m)	Health	Structure	Retention value	DBH (mm)	TPZ (m)	Impact
102	*Casuarina cunninghamiana*	1	10	5	Poor	Fair	Low	350	4.2	No impact (0%)
103	*Corymbia maculata*	1	24	15	Good	Good	High	600	7.2	No impact (0%)
104	*Olea africana*	1	4	6	Good	Fair	Low	250	3	No impact (0%)
105	*Casuarina cunninghamiana*	1	12	10	Fair	Good	Medium	350	4.2	No impact (0%)
106	*Corymbia maculata*	1	20	12	Good	Good	Medium	450	5.4	No impact (0%)
107	*Corymbia maculata*	1	22	15	Good	Good	High	500	6	No impact (0%)
108	*Corymbia maculata*	1	20	15	Fair	Fair	Medium	450	5.4	High impact (>20%)
109	*Corymbia maculata*	1	16	15	Good	Good	Medium	450	5.4	High impact (>20%)
110	*Allocasuarina torulosa*	1	10	8	Fair	Good	Medium	400	4.8	High impact (>20%)
111	*Allocasuarina torulosa*	1	10	8	Fair	Fair	Medium	400	4.8	High impact (>20%)
112	*Casuarina cunninghamiana*	1	10	10	Good	Good	Medium	400	4.8	No impact (0%)
113	*Casuarina cunninghamiana*	1	10	10	Good	Fair	Medium	450	5.4	No impact (0%)
114	*Casuarina cunninghamiana*	1	10	7	Fair	Fair	Medium	400	4.8	No impact (0%)

Ref.	Species	Trees in group	Height (m)	Spread (m)	Health	Structure	Retention value	DBH (mm)	TPZ (m)	Impact
115	*Casuarina cunninghamiana*	1	12	8	Fair	Fair	Medium	450	5.4	No impact (0%)
116	*Casuarina cunninghamiana*	1	14	8	Good	Good	Medium	400	4.8	No impact (0%)
117	*Casuarina cunninghamiana*	1	10	8	Good	Good	Medium	350	4.2	No impact (0%)
118	*Corymbia citriodora*	1	14	12	Poor	Fair	Medium	450	5.4	No impact (0%)
119	*Corymbia maculata*	1	12	10	Fair	Fair	Medium	400	4.8	No impact (0%)
120	*Corymbia citriodora*	1	8	5	Fair	Fair	Low	150	2	No impact (0%)
121	*Corymbia citriodora*	1	15	12	Fair	Fair	Medium	450	5.4	No impact (0%)
122	*Corymbia citriodora*	1	14	12	Poor	Fair	Medium	400	4.8	No impact (0%)
123	*Corymbia citriodora*	1	14	10	Fair	Fair	Medium	250	3	No impact (0%)
124	*Corymbia citriodora*	1	15	12	Poor	Poor	Low	350	4.2	High impact (>20%)
125	*Corymbia citriodora*	1	12	12	Fair	Fair	Medium	350	4.2	High impact (>20%)
126	*Corymbia citriodora*	1	12	6	Fair	Fair	Medium	200	2.4	High impact (>20%)
127	*Corymbia citriodora*	1	18	12	Good	Good	Medium	450	5.4	High impact (>20%)
128	*Corymbia citriodora*	1	12	5	Fair	Good	Medium	300	3.6	High impact (>20%)
129	*Corymbia citriodora*	1	16	12	Fair	Fair	Medium	400	4.8	High impact (>20%)

Ref.	Species	Trees in group	Height (m)	Spread (m)	Health	Structure	Retention value	DBH (mm)	TPZ (m)	Impact
130	*Corymbia citriodora*	1	10	10	Poor	Fair	Medium	400	4.8	High impact (>20%)
131	*Corymbia citriodora*	1	6	5	Fair	Good	Medium	200	2.4	High impact (>20%)
132	*Pinus radiata*	1	13	12	Fair	Good	Medium	350	4.2	High impact (>20%)
133	*Corymbia maculata*	1	12	12	Good	Fair	Medium	450	5.4	High impact (>20%)
134	*Corymbia maculata*	1	10	5	Good	Good	Medium	300	3.6	High impact (>20%)
136	*Corymbia maculata*	1	10	5	Fair	Good	Medium	300	3.6	High impact (>20%)
137	*Corymbia maculata*	1	14	10	Fair	Good	Medium	300	3.6	High impact (>20%)
138	*Corymbia maculata*	1	12	10	Good	Good	Medium	400	4.8	High impact (>20%)
139	*Corymbia maculata*	1	12	14	Good	Fair	Medium	450	5.4	High impact (>20%)
140	*Corymbia maculata*	1	8	6	Fair	Fair	Medium	250	3	High impact (>20%)
141	*Corymbia maculata*	1	15	12	Fair	Good	Medium	450	5.4	High impact (>20%)
142	*Corymbia citriodora*	1	12	12	Fair	Good	Medium	350	4.2	High impact (>20%)
143	*Corymbia maculata*	1	18	10	Fair	Good	Medium	350	4.2	High impact (>20%)
144	*Corymbia citriodora*	1	10	8	Good	Good	Medium	250	3	High impact (>20%)
145	*Corymbia citriodora*	1	10	4	Fair	Good	Low	200	2.4	High impact (>20%)
146	*Corymbia citriodora*	1	10	10	Fair	Fair	Medium	300	3.6	High impact (>20%)
147	*Corymbia maculata*	1	12	8	Fair	Fair	Medium	350	4.2	High impact (>20%)

Ref.	Species	Trees in group	Height (m)	Spread (m)	Health	Structure	Retention value	DBH (mm)	TPZ (m)	Impact
148	*Corymbia citriodora*	1	10	8	Good	Fair	Medium	300	3.6	High impact (>20%)
149	*Eucalyptus leucoxylon*	1	8	7	Good	Good	Medium	250	3	High impact (>20%)
150	*Corymbia citriodora*	10	12	30	Fair	Good	Medium	200	2.4	High impact (>20%)
151	*Eucalyptus leucoxylon*	5	5	10	Fair	Fair	Medium	200	2.4	High impact (>20%)

Appendix C Tree Protection Guidelines

The following tree protection guidelines must be implemented during the construction period in the event that no tree-specific recommendations are detailed.

Tree protection fencing

The TPZ is a restricted area delineated by protective fencing or the use of an existing structure (such as a wall or fence).

Trees that are to be retained must have protective fencing erected around the TPZ (or as specified in the body of the report) to protect and isolate it from the construction works. Fencing must comply with the *Australian Standard, AS 4687-2007, Temporary fencing and hoardings*.

Tree protection fencing must be installed prior to site establishment and remain intact until completion of works. Once erected, protective fencing must not be removed or altered without the approval of the project arborist.

If the protective fencing requires temporary removal, trunk, branch and ground protection must be installed and must comply with *AS 4970-2009, Protection of Trees on Development Sites*.

Tree protection fencing shall be:

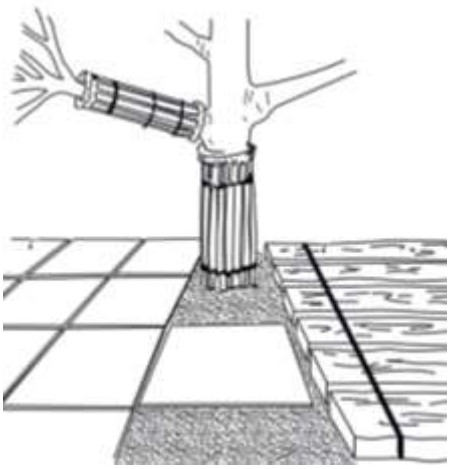
- Enclosed to the full extent of the TPZ (or as specified in the Recommendations and Tree Protection Plan).
- Cyclone chain wire link fence or similar, with lockable access gates.
- Certified and Inspected by the Project Arborist.
- Installed prior to the commencement of works.
- Prominently signposted with 300mm x 450mm boards stating “NO ACCESS - TREE PROTECTION ZONE”.

Crown protection

Tree crowns/canopy may be injured or damaged by machinery such as; excavators, drilling rigs, trucks, cranes, plant and vehicles. Where crown protection is required, it will usually be located at least one meter outside the perimeter of the crown.

Crown protection may include the installation of a physical barrier, pruning selected branches to establish clearance, or the tying/bracing of branches.

Trunk protection



Where provision of tree protection fencing is impractical or must be temporarily removed, truck protection shall be installed for the nominated trees to avoid accidental mechanical damage.

The removal of bark or branches allows the potential ingress of micro-organisms which may cause decay. Furthermore, the removal of bark restricts the trees' ability to distribute water, mineral ions (solutes), and glucose.

Trunk protection shall consist of a layer of either carpet underfelt, geotextile fabric or similar wrapped around the trunk, followed by 1.8 m lengths of softwood timbers aligned vertically and spaced evenly around the trunk (with an approx. 50 mm gap between the timbers).

The timbers must be secured using galvanised hoop strap (aluminium strapping). The timbers shall be wrapped around the trunk but not fixed to the tree, as this will cause injury/damage to the tree.

Ground protection

Tree roots are essential for the uptake/absorption of water, oxygen and mineral ions (solutes). It is essential to prevent the disturbance of the soil beneath the dripline and within the TPZ of trees that are to be retained. Soil compaction within the TPZ will adversely affect the ability of roots to function correctly.

If temporary access for machinery is required within the TPZ ground protection measures will be required. The purpose of ground protection is to prevent root damage and soil compaction within the TPZ. Ground protection may include a permeable membrane such as geotextile fabric beneath a layer of mulch, crushed rock or rumble boards.

If the grade is to be raised within the TPZ, the material should be coarser or more porous than the underlying material.

Root protection & pruning

If incursions/excavation within the TPZ are unavoidable, exploratory excavation (under the supervision of the Project Arborist) using non-destructive methods may be considered to evaluate the extent of the root system affected, and determine whether or not the tree can remain viable.

If the project arborist identifies conflicting roots that requiring pruning, they must be pruned with a sharp implement such as; secateurs, pruners, handsaws or a chainsaw back to undamaged tissue. The final cut must be a clean cut.

Underground services

All underground services should be routed outside of the TPZ. If underground services need to be installed within the TPZ, they should be installed using horizontal directional drilling (HDD). The horizontal drilling/boring must be at minimum depth of 600mm below grade. Trenching for services is to be regarded as "excavation"

Appendix D Tree retention assessment method

Tree Significance - Assessment Criteria - STARS©		
Low	**Medium**	**High**
The tree is in fair-poor condition and good or low vigour. The tree has form atypical of the species The tree is not visible or is partly visible from the surrounding properties or obstructed by other vegetation or buildings The tree provides a minor contribution or has a negative impact on the visual character and amenity of the local area The tree is a young specimen which may or may not have reached dimensions to be protected by local Tree Preservation Orders or similar protection mechanisms and can easily be replaced with a suitable specimen The tree's growth is severely restricted by above or below ground influences, unlikely to reach dimensions typical for the taxa in situ – tree is inappropriate to the site conditions The tree is listed as exempt under the provisions of the local Council Tree Preservation Order or similar protection mechanisms The tree has a wound or defect that has the potential to become structurally unsound. The tree is an environmental pest species due to its invasiveness or poisonous/allergenic properties. The tree is a declared noxious weed by legislation	The tree is in fair to good condition The tree has form typical or atypical of the species The tree is a planted locally indigenous or a common species with its taxa commonly planted in the local area The tree is visible from surrounding properties, although not visually prominent as partially obstructed by other vegetation or buildings when viewed from the street The tree provides a fair contribution to the visual character and amenity of the local area The tree's growth is moderately restricted by above or below ground influences, reducing its ability to reach dimensions typical for the taxa in situ	The tree is in good condition and good vigour The tree has a form typical for the species The tree is a remnant or is a planted locally indigenous specimen and/or is rare or uncommon in the local area or of botanical interest or of substantial age. The tree is listed as a heritage item, threatened species or part of an endangered ecological community or listed on councils significant tree register The tree is visually prominent and visible from a considerable distance when viewed from most directions within the landscape due to its size and scale and makes a positive contribution to the local amenity. The tree supports social and cultural sentiments or spiritual associations, reflected by the broader population or community group or has commemorative values. The tree's growth is unrestricted by above and below ground influences, supporting its ability to reach dimensions typical for the taxa in situ – tree is appropriate to the site conditions.

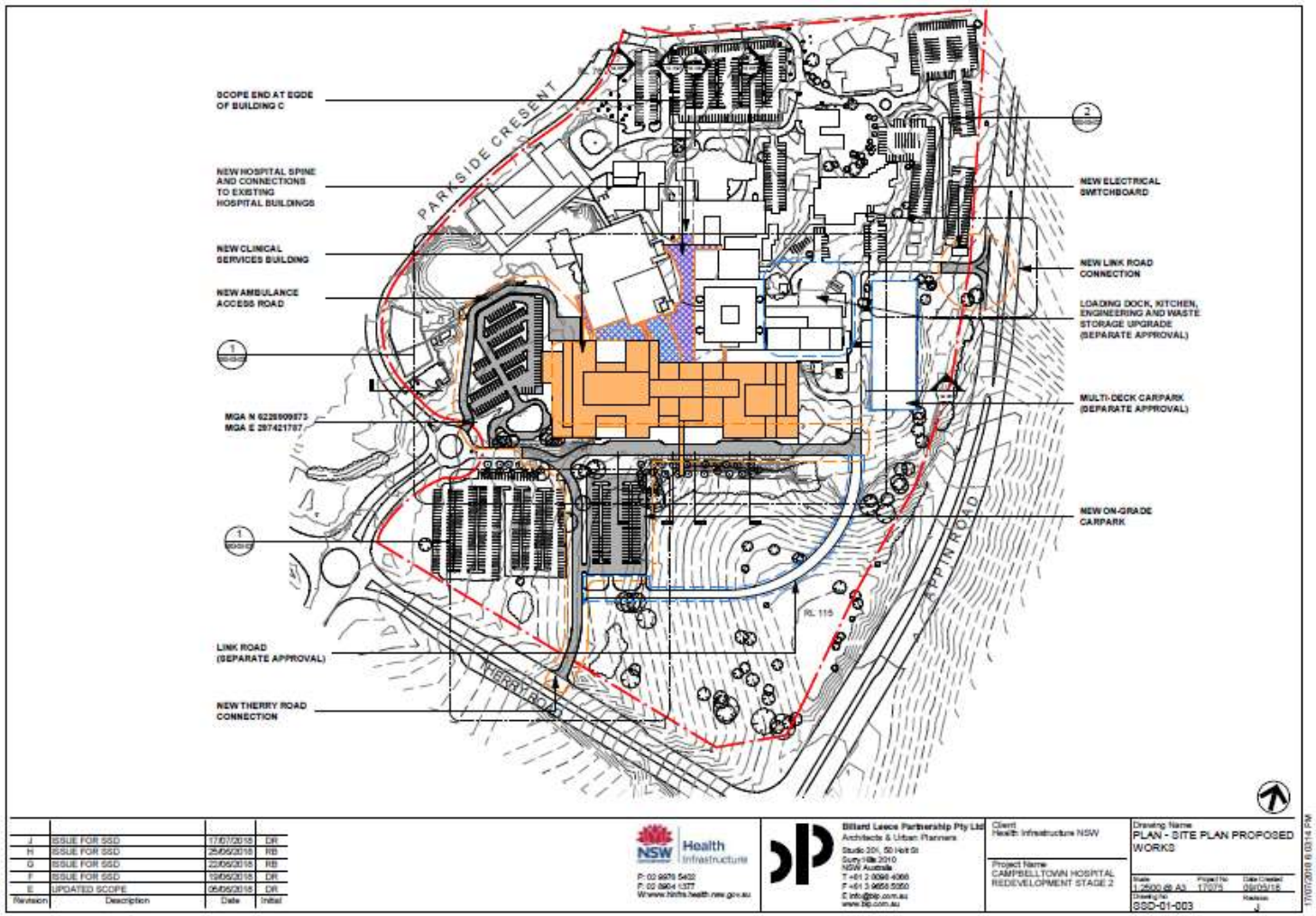
Tree Significance

Useful Life Expectancy	High	Medium	Low		
Long >40 years					
Medium 15-40 years					
Short <1-15 years					
Dead					

Legend for Matrix Assessment

	Priority for retention (High): These trees are considered important for retention and should be retained and protected. Design modification or re-location of building/s should be considered to accommodate the setbacks as prescribed by the Australian Standard AS4970 Protection of trees on development sites. Tree sensitive construction measures must be implemented if works are to proceed within the Tree Protection Zone.
	Consider for retention (Medium): These trees may be retained and protected. These are considered less critical; however their retention should remain priority with the removal considered only if adversely affecting the proposed building/works and all other alternatives have been considered and exhausted.
	Consider for removal (Low): These tree are not considered important for retention, nor require special works or design modification to be implemented for their retention.
	Consider for removal (Low): These tree are not considered important for retention, nor require special works or design modification to be implemented for their retention.

Appendix E Proposed Scope Plan



ecological AUSTRALIA

bsi. ISO 14001 Environmental Management

bsi. AS/NZS 4801:2001 Occupational Health and Safety Management

bsi. ISO 9001 Quality Management